Lower Salmon River Spring/Summer Chinook Salmon Population
Population Viability Assessment

The Lower Salmon River chinook population (Figure 1) is part of the Snake River Spring/Summer Chinook ESU which has five major population groupings (MPGs), including: Lower Snake River, Grande Ronde / Imnaha, South Fork Salmon River, Middle Fork Salmon River, and the Upper Salmon River group. The ESU contains both spring and summer run chinook. The Lower Salmon River population is a spring/summer run and is one of eight extant populations in the Upper Salmon River MPG.

The ICTRT classified the Lower Salmon River population as a "very large" population (Table 1) based on historical habitat potential (ICTRT 2005). A chinook population classified as very large has a mean minimum abundance threshold criteria of 2000 naturally produced spawners with a sufficient intrinsic productivity to achieve a 5% or less risk of extinction over a 100-year timeframe.

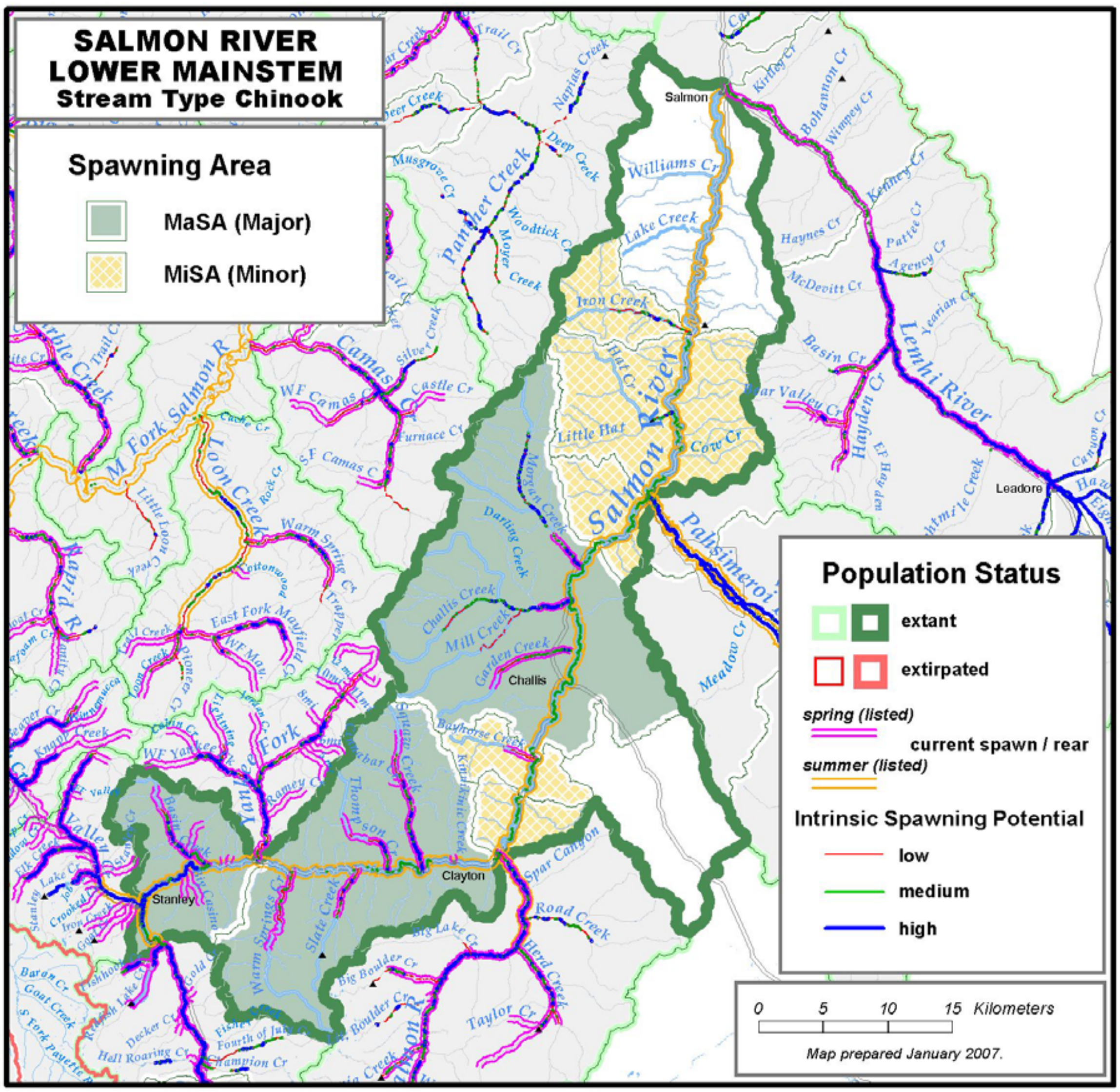

Figure 1. Lower Salmon River chinook major and minor spawning areas.

Table 1. Lower Salmon River chinook basin statistics

Drainage Area (km2)	4,361
Stream lengths km* (total)	1,096
Stream lengths km* (below natural barriers)	954
Branched stream area weighted by intrinsic potential (km2)	1.014
Branched stream area km2 (weighted and temp. limited)	1.014
Total stream area weighted by intrinsic potential (km2)	1.431
Total stream area weighted by intrinsic potential (km2) temp limited	1.431
Size / Complexity category	Very Large / "C" (trellis pattern)
Number of MaSAs	3
Number of MiSAs	5

*All stream segments greater than or equal to 3.8m bankfull width were included
**Temperature limited areas were assessed by subtracting area where the mean weekly modeled water temperature was greater than 22ºC.

Current Abundance and Productivity

Current (1957 to 2005) abundance (number of adult spawning in natural production areas) has ranged from 11 in 1995 to 4,888 in 1957 (Figure 2). Annual abundance estimates for the Lower Salmon River were based on expanded redd counts. Insert expansion methodology here

Recent year natural spawners include returns originating from naturally spawning parents. It is possible a small number of hatchery fish spawn naturally in the upper reach of the population boundary, fish that did not return to the upstream Sawtooth Fish Hatchery. However, there is not a large amount of suitable spawning habitat in the uppermost 2-3 miles of the population and hatchery fish do not hold and spawn in this area but migrate to the higher quality habitat just upstream of the population boundary. Since 1988 an average of only 7% of the total redds observed for the entire population were located between Redfish Lake Creek and Valley Creek. Spawners originating from naturally spawning parents are assumed to have comprised an average of 100% since 1962 (Table 2).

Abundance in recent years has been highly variable, the most recent 10-year geomean number of natural origin spawners was 123 (Table 2). During the period 1981-2000, returns per spawner for chinook in the Lower Salmon River ranged from 0.18 in 1991 to 7.82 in 1995. The most recent 20 year (1981-2000) SAR adjusted and delimited (at 75% of the size threshold) geometric mean of returns per spawner was 1.25 (Table 2).

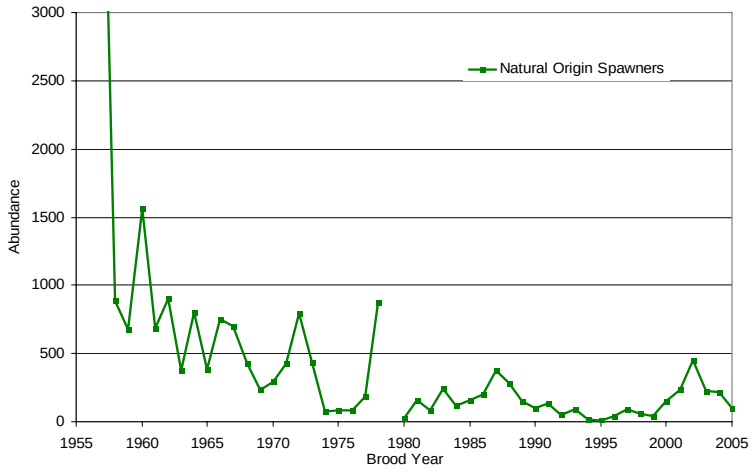

Figure 2. Lower Salmon River abundance trends 1957-2005.

Table 2. Lower Salmon River abundance and productivity measures

10-year geomean natural abundance	123
20-year return/spawner productivity	1.23
20-year return/spawner productivity, SAR adj. and delimited*	1.25
20-year Bev-Holt fit productivity, SAR adjusted	n/a
20-year Lambda productivity estimate	1.02
Average proportion natural origin spawners (recent 10 years)	1.0
Reproductive success adj. for hatchery origin spawners	n/a

*Delimited productivity excludes any spawner/return pair where the spawner number exceeds 75% of the size category threshold for this population. This approach attempts to remove density dependence effects that may influence the productivity estimate.

Comparison to the Viability Curve

- Abundance: 10-yr geomean natural origin spawners
- Productivity: 20-yr geomean R/S (adjusted for marine survival and delimited at 1500 spawners)
- Curve: Hockey-Stick curve
- Conclusion: The Lower Salmon River chinook population is at **HIGH** risk based on current abundance and productivity. The point estimate resides below the 25% risk curve (Figure 3).

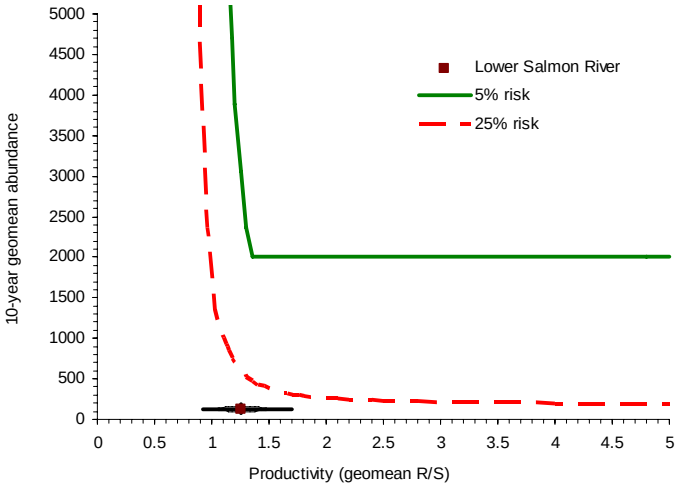

Figure 3. Lower Salmon River Spring Chinook abundance and productivity metrics against a Hockey-Stick viability curve. Dataset adjusted for marine survival and delimited at 75% threshold. Estimate includes a 1 SE ellipse, 1.81 X SE abundance line, and 1.72 X SE productivity line.

Spatial Structure and Diversity

The ICTRT has identified three major spawning areas (MaSAs) and five minor spawning areas (MiSA) within the Lower Salmon River chinook population. There are no modeled temperature limitations within this MaSA. Historically most spawning occurred in the mainstem from Valley Creek downstream to approximately the city of Challis. From 1958 through 1973 the annual average proportion of redds in that reach was 80%. Since 1984 the annual average of redds in that reach was 84%.

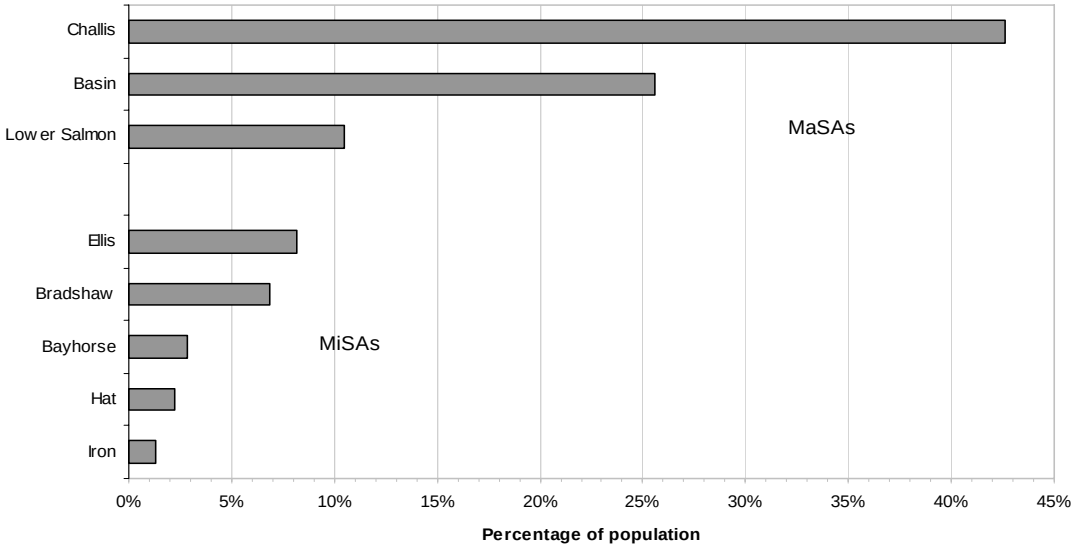

Figure 4. The Lower Salmon River Spring Chinook population contains three MaSAs, and five MiSAs. There are no modeled temperature limitations within this population.

Factors and Metrics

A.1.a. Number and spatial arrangement of spawning areas.

The Lower Salmon Mainstem Chinook population has three MaSAs () and five MiSAs. The total branched stream area weighted by intrinsic potential is 741,467 m^2, an area equivalent to 7.4 MaSAs. This metric is rated *Very Low Risk* even though no intrinsic habitat lies outside of the MaSAs because of the large amount of area in the three MaSAs in a non-linear confiuration.

A.l.b. Spatial extent or range of population.

The IDFG has conducted annual spawner index counts since 1957 within the boundaries of this population from Redfish Lake Creek downstream to the mouth of the Lemhi River. The area counted is divided into eight transects. From 1980 through 1986 some of the transects downstream of Challis were not counted. The lower most MaSA has not been occupied (ICTRT definition) since 1983, and was occupied only 2 years since 1979. Since 1979 the number of redds counted in the Salmon River between the East Fork Salmon and Lemhi rivers range from 0 (many years) to 11, except in 1987 when 19 redds were counted. Historically that section contained an average of 26% of the total redds counted in the population; in the recent three brood cycles 5% (annual average) of the total redds were counted in that section. This metric is rated *Moderate Risk* because only 67% (2 of 3) historical MaSAs are occupied.

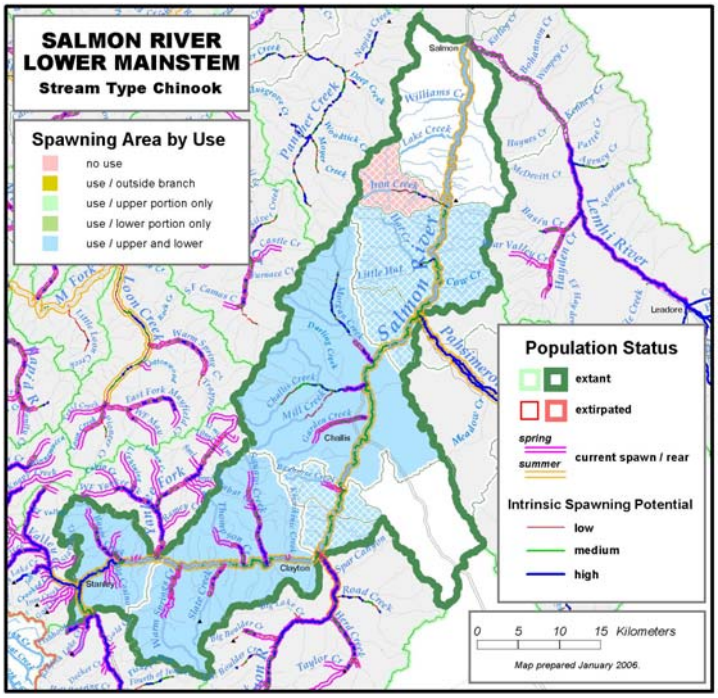

Figure 5. Lower Salmon River chinook distribution.

A.1.c. Increase or decrease in gaps or continuities between spawning areas.

The MaSAs and MiSAs downstream of the East Fork Salmon River currently are not occupied. Lack of occupancy in the downstream most MaSA does not create a gap between MaSAs but may disrupt connectivity between the Lower Salmon River mainstem, East Fork Salmon River, Pahsimeroi River and Lemhi River populations. Because of the potentially large disruption in connectivity and the number of populations potentially affected this metric was rated *Moderate* risk.

B.1.a. Major life history strategies.

There are limited data to allow any comparisons between historic and current life history strategies. The IDFG classifies the entire population as summer run. The major juvenile life history strategy is suspected to be a spring yearling migrant to the ocean. The almost total loss of spawners downstream of the East Fork Salmon River may indicated loss of a life history strategy

or a substantial change in phenotypic variation (metric B.1.b). Fish spawning in that area tended to spawn later because of warmer water temperatures, and the progeny of those spawners may have migrated to the ocean at an earlier age. Recent PIT-tag data from the Pahsimeroi River indicates a high proportion of juveniles leave that river and arrive at Lower Granite Dam as subyearling migrants rather than yearling migrants. The subyearlings arrive at Lower Granite Dam in June and July. No adults have been detected as returning from subyearling migrants. It is not known if all historic juvenile and adult life history strategies are present, but because data is limited the metric is rated *Low Risk*.

B.1.b. Phenotypic variation.

There is anecdotal information indicating that phenotypic traits may have been significantly changed or lost (see discussion under B.1.a). No alterations of within-basin habitat conditions that could have resulted in loss of a phenotypic trait are known to have occurred. Changes in the mainstem migration corridor (lower Snake and Columbia rivers) likely have altered timing of juvenile downstream passage and adult upstream passage. Because smolt entry into the estuary is substantially delayed relative to historic conditions and there potentially has been a substantial change in spawn timing, this metric is rated at *Moderate Risk.*

B.1.c. Genetic variation.

There is no genetic data for this population to use in assessing this metric, therefore it is rated *Moderate Risk.* Lack of genetic data will constrain Goal B risk and overall spatial structure/diversity risk to never being lower than Moderate.

B.2.a. Spawner composition.

Spawner composition typically is determined from spawning ground carcass recoveries. Any marked fish that are recovered are examined for the presence of a coded-wire or PIT tag. Spawner carcass data is not collected within this population. Risk ratings are inferred from data collected in proximate populations. From 1981 through 2004 3,955 marked fish were recovered in the upstream Upper Salmon River population (at Sawtooth Fish Hatchery) and a CWT was extracted and read from 3,932 of those fish. From 1980 through 2004 551 marked fish were recovered in the downstream Pahsimeroi River population (at Pahsimeroi Fish Hatchery) and a CWT was extracted and read from all fish.

(1) *Out-of-ESU strays*. In the upstream Upper Salmon River Mainstem population, four out-of-ESU strays were recovered at the Sawtooth Hatchery across the 23 years of data reviewed. Two were fall Chinook that had been reared in the Hagerman Valley, one was a stray from the Tucannon River and one was a stray from the Umatilla River. Those four fish most likely were spawned in the hatchery, thus did not spawn naturally. In the Pahsimeroi population, one out-of-ESU fish was trapped in 1984; its origin was the Rogue River in Oregon. No expansions were done to account for unmarked returns from the respective mark groups. This sub-metric is rated *Very Low* risk since the total number observed was very low.

(2) *Out-of-MPG strays from within the ESU*. Five out-of-MPG strays were recovered at the Sawtooth Hatchery across the 23 years of data reviewed. Two of the strays were Rapid River origin and two were South Fork Salmon River origin. Four out-of-MPG strays were recovered at the Pahsimeroi Fish Hatchery over 24 years of data surveyed. All were Rapid River stock; two

(one each in 1988 and 1999) were reared and released at Rapid River and two (one each in 1976 and 1977) were reared in a facility on Hayden Creek (tributary to the Lemhi River). No expansions were done to account for unmarked returns from the respective mark groups. This sub-metric is rated *Low* risk.

(3) *Out of population within MPG strays*. Out-of-population hatchery-origin strays that could enter the population in recent years would originate from the upstream Upper Salmon River Mainstem population (Sawtooth Hatchery) or the Pahsimeroi Hatchery program operated in the Pahsimeroi River population. Proportion of strays spawning naturally is suspected to be less than 10% per year, and this sub-metric is rated *Low Risk*.

(4) *Within-population hatchery spawners.* There is no within population hatchery program, and this sub-metric is rated *Very Low* risk.

The overall risk rating for metric B.2.a "spawner composition" is *Low Risk* even no out-of-population strays have actually been observed.

B.3.a. Distribution of population across habitat types.

The Lower Salmon River Mainstem population intrinsic potential distribution historically was distributed across five EPA level IV ecoregions, with Dry Intermontane Sagebrush Valleys being predominant. The current distribution is similar to the historic intrinsic distribution (Table 3 and Fig. 6). There are no substantial changes in ecoregion occupancy and this metric was rated *Very Low Risk* for the population.

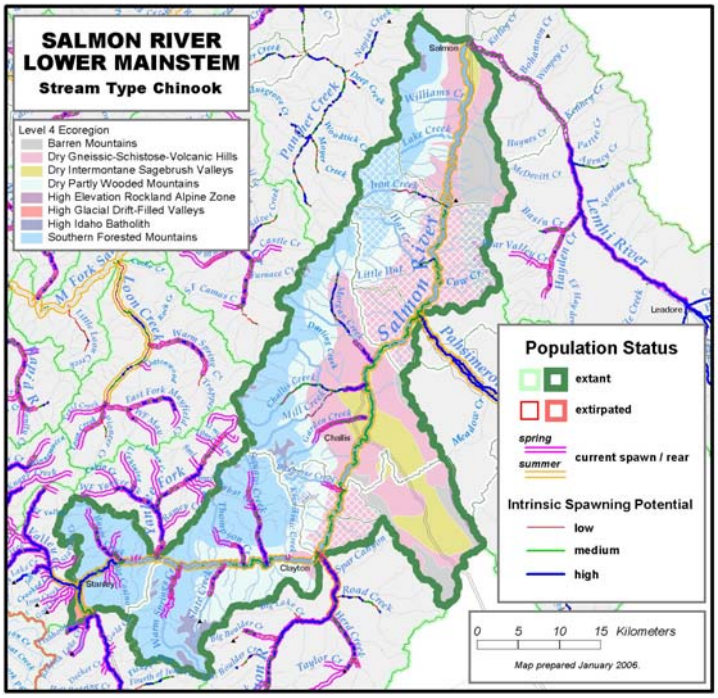

Figure 6. Lower Salmon River chinook population distribution across various ecoregions.

Table 3. Lower Salmon River chinook—proportion of spawning areas across various ecoregions.

Ecoregion	% of historical branch spawning area in this ecoregion (non-temperature limited)	% of historical branch spawning area in this ecoregion (temperature limited)	% of currently occupied spawning area in this ecoregion (non-temperature limited)
Dry Gneissic-Schistose Volcanic Hills	21.9	21.9	25.0
Dry Intermontane Sagebrush Valleys	47.1	47.1	40.9
Dry Partly Wooded Mountains	9.4	9.4	9.1
High Glacial Drift-Filled Valleys	0.5	0.5	5.3
Southern Forested Mountains	21.2	21.2	19.6

B.4.a. Selective change in natural processes or selective impacts.

Hydropower system: The hydrosystem and associated reservoirs impose some selective mortality on smolt outmigrants and adult migrants, the selective mortality is not likely to remove more than 25% of the affected individuals. The likely impacts are rated as *Low Risk* for this action.

Harvest: Recent harvest impact rates for spring/summer Chinook salmon are generally less than 10% annually. There are no freshwater fisheries directly targeting naturally produced spring/summer Chinook salmon; indirect mortalities are expected to occur in some fisheries selective for hatchery fish. In 2005 there was a limited sport fishery in the mainstem Salmon River just downstream of the Pahsimeroi River to target marked hatchery summer Chinook salmon returning to Pahsimeroi Fish Hatchery. Some indirect mortalities were expected to occur through the execution of the fishery. It is not likely that the mortality is selective for a particular group of fish or if it is, it would not select 25% or more of that particular group and this action is as *Very Low Risk*.

Hatcheries: There are no hatchery programs within this population and hatchery programs in proximate populations are not suspected to have a selective impact on this population. The selective impact of hatchery actions was rated as *Low* risk.

Habitat: Habitat changes resulting from land use activities in the basin may impose some selective mortality, but the extent is unknown. It is likely that any selective mortality impacts would affect a non-negligible portion of the population. The effects of land use activities upstream of the population boundary likely does not impose selective mortality on this population. This selective impact was rated *Low Risk*.

Spatial Structure and Diversity Summary

Overall spatial structure and diversity has been rated *Low Risk* for the Lower Salmon River Mainstem population (Table 4). The lowest spatial structure/diversity risk level the population could achieve would be Very Low risk because of the historic (natural) number and spatial arrangement of spawning areas and large total amount of intrinsic potential habitat. The current *Low* risk rating is driven by loss of occupancy from a large amount if historically used habitat, especially in the downstream half of the population area. With a substantial increase in abundance these areas may again become occupied, unless a major life history strategy or phenotypic trait has been lost as discussed for metrics B.1.a and B.1.b.

Table 4. Spatial structure and diversity scoring table

<table>
<tr><th rowspan="2">Metric</th><th colspan="5">Risk Assessment Scores</th></tr>
<tr><th>Metric</th><th>Factor</th><th>Mechanism</th><th>Goal</th><th>Population</th></tr>
<tr><td>A.1.a</td><td>VL (2)</td><td>VL (2)</td><td rowspan="3">Low Risk
(Mean=1.33)</td><td rowspan="3">Low Risk</td><td rowspan="15">Low Risk</td></tr>
<tr><td>A.1.b</td><td>M (0)</td><td>M (0)</td></tr>
<tr><td>A.1.c</td><td>M (0)</td><td>M (0)</td></tr>
<tr><td>B.1.a</td><td>L (1)</td><td>L (1)</td><td rowspan="3">Low Risk</td><td rowspan="10">Low Risk</td></tr>
<tr><td>B.1.b</td><td>M (0)</td><td>M (0)</td></tr>
<tr><td>B.1.c</td><td>L (1)</td><td>L (1)</td></tr>
<tr><td>B.2.a(1)</td><td>VL (2)</td><td rowspan="4">L (1)</td><td rowspan="4">Low Risk</td></tr>
<tr><td>B.2.a(2)</td><td>L (1)</td></tr>
<tr><td>B.2.a(3)</td><td>L (1)</td></tr>
<tr><td>B.2.a(4)</td><td>VL (2)</td></tr>
<tr><td>B.3.a</td><td>VL (2)</td><td>VL (2)</td><td>Very Low risk</td></tr>
<tr><td>B.4.a</td><td>L (1)</td><td>L (1)</td><td>Low Risk</td></tr>
</table>

Overall Viability Rating

The Lower Salmon River Mainstem spring/summer Chinook salmon population does not currently meet viability criteria because neither Abundance/Productivity risk nor Spatial Structure/Diversity risk meets the criteria for a viable population (Table 5). The 20-year delimited recruit per spawner point estimate is above replacement (1.25), but less than the 1.45 required at the minimum threshold abundance. The 10-year geometric mean abundance (123) is only 6% of the minimum threshold abundance. Substantial improvements in abundance/productivity status (reduction of risk level) will need to occur before the population can be considered viable. Also, the population currently does not meet the criteria for a "maintained" population.

		Spatial Structure/Diversity Risk			
		Very Low	**Low**	**Moderate**	**High**
Abundance/ Productivity Risk	**Very Low** (<1%)	HV	HV	V	M
	Low (1-5%)	V	V	V	M
	Moderate (6 – 25%)	M	M	M	
	High (>25%)		**Lower Salmon**		

Figure 7. Viable Salmonid Population parameter risk ratings for the Lower Salmon River Spring/Summer Chinook population. This population does not currently meet viability criteria. *Viability Key: HV – Highly Viable; V – Viable; M – Maintained; Shaded cells-- not meeting viability criteria (darkest cells are at greatest risk)*

Lower Salmon River Chinook – Data Summary

Data type: Redd count expansions
SAR: Averaged Williams/CSS series

Table 5. Lower Salmon River Chinook run data (used for curve fits and R/S analysis). All available return/spawner data were used since the parent escapement never exceeded 75% of the size threshold.

Brood Year	Spawners	%Wild	Natural Run	Nat. Rtns	R/S	Rel. SAR	Adj. Rtns	Adj. R/S
1981	**162**	**1**	**162**	**167**	**1.03**	**0.63**	**105**	**0.65**
1982	**84**	**1**	**84**	**256**	**3.05**	**0.51**	**130**	**1.55**
1983	**239**	**1**	**239**	**312**	**1.31**	**0.57**	**179**	**0.75**
1984	**121**	**1**	**121**	**248**	**2.05**	**1.65**	**409**	**3.38**
1985	**158**	**1**	**158**	**151**	**0.96**	**1.57**	**237**	**1.50**
1986	**200**	**1**	**200**	**118**	**0.59**	**1.41**	**166**	**0.83**
1987	**372**	**1**	**372**	**95**	**0.26**	**1.82**	**173**	**0.47**
1988	**285**	**1**	**285**	**78**	**0.27**	**0.74**	**58**	**0.20**
1989	**148**	**1**	**148**	**57**	**0.39**	**1.79**	**102**	**0.69**
1990	**98**	**1**	**98**	**26**	**0.27**	**4.62**	**120**	**1.22**
1991	**131**	**1**	**131**	**24**	**0.18**	**3.00**	**72**	**0.55**
1992	**50**	**1**	**50**	**56**	**1.12**	**1.64**	**92**	**1.84**
1993	**92**	**1**	**92**	**72**	**0.78**	**1.60**	**115**	**1.25**
1994	**17**	**1**	**17**	**58**	**3.41**	**1.03**	**60**	**3.53**
1995	**11**	**1**	**11**	**86**	**7.82**	**0.59**	**51**	**4.64**
1996	**44**	**1**	**44**	**165**	**3.75**	**0.54**	**89**	**2.02**
1997	**92**	**1**	**92**	**299**	**3.25**	**0.29**	**88**	**0.96**
1998	**59**	**1**	**59**	**331**	**5.61**	**0.30**	**98**	**1.66**
1999	**44**	**1**	**44**	**257**	**5.84**	**0.65**	**166**	**3.77**
2000	**154**	**1**	**154**	**177**	**1.15**	**1.00**	**177**	**1.15**
2001	231	1	231					
2002	449	1	449					
2003	223	1	223					
2004	221	1	221					
2005	102	1	102					

Table 6. Geomean abundance and productivity measures. Boxed values were used in evaluating the current status of this population.

	R/S measures				Lambda measures		Abundance
	Not adjusted		SAR adjusted		Not adjusted		Nat. origin
delimited	median	75% threshold	median	75% threshold	1989-2000	1981-2000	geomean
Point Est.	2.44	1.23	1.98	1.25	1.07	1.02	123
Std. Err.	0.33	0.26	0.17	0.18	0.25	0.27	0.25
count	10	20	10	20	12	20	10

Table 7. Poptools stock-recruitment curve fit parameter estimates. Values potentially indicating a non-fit are highlighted in gray.

	Not adjusted for SAR							Adjusted for SAR						
SR Model	a	SE	b	SE	adj. var	auto	AICc	a	SE	b	SE	adj. var	auto	AICc
Rand-Walk	1.23	0.31	n/a	n/a	0.60	0.73	66.2	1.24	0.21	n/a	n/a	0.51	0.38	50.9
Const. Rec	117	20	n/a	n/a	n/a	n/a	51.4	118	13	n/a	n/a	n/a	n/a	33.6
Bev-Holt	22.41	42.56	127	30	0.15	0.86	53.8	6.81	3.21	156	25	0.15	0.41	29.8
Hock-Stk	1.23	0.18	523	0	0.60	0.73	69.0	4.05	1.23	32	10	0.14	0.48	30.7
Ricker	3.68	1.18	0.00854	0.00205	0.29	0.76	56.5	2.98	0.53	0.00684	0.00115	0.20	0.27	33.2

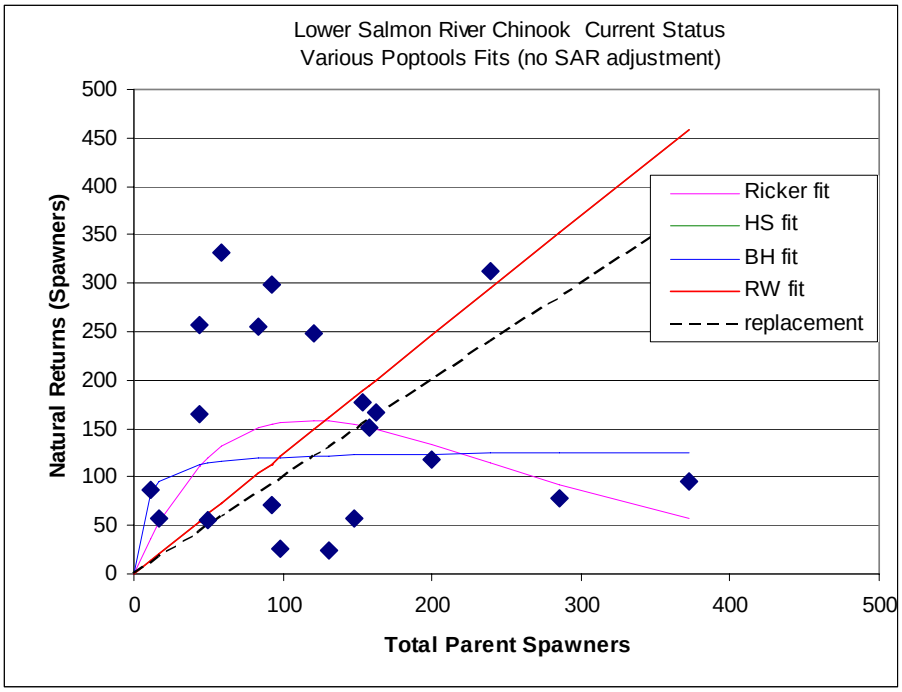

Figure 8. Stock recruitment curves for the Lower Salmon River Chinook population. Data not adjusted for marine survival.

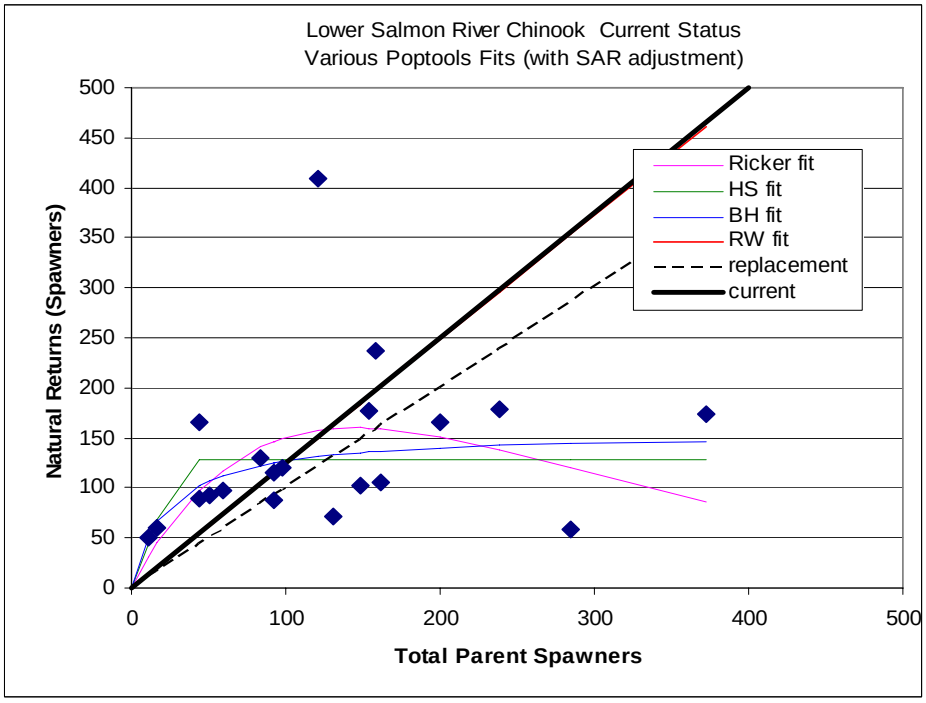

Figure 9. Stock-recruitment curves for the Lower Salmon River Chinook population. Data adjusted for marine survival.